Mapping Impact of Urbanization in the Continental U.S. from 2001-2020
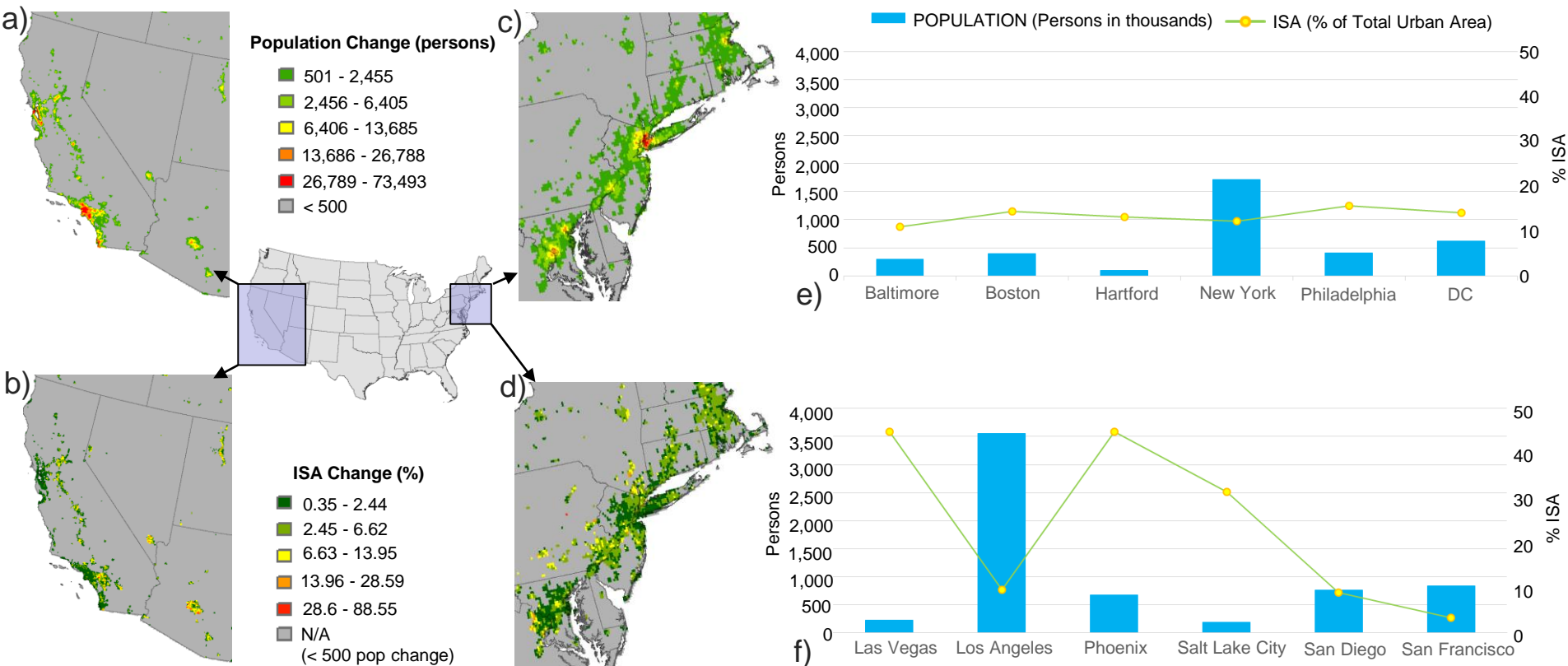
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Population Change (persons)
- 501 - 2,455
- 2,456 - 6,405
- 6,406 - 13,685
- 13,686 - 26,788
- 26,789 - 73,493
- < 500

ISA Change (%)
- 0.35 - 2.44
- 2.45 - 6.62
- 6.63 - 13.95
- 13.96 - 28.59
- 28.6 - 88.55
- N/A (< 500 pop change)

POPULATION (Persons in thousands) — ISA (% of Total Urban Area)

e) Baltimore, Boston, Hartford, New York, Philadelphia, DC

f) Las Vegas, Los Angeles, Phoenix, Salt Lake City, San Diego, San Francisco

Synopsis: We used data fusion from Landsat and MODIS to characterize US buildup and to derive a plausible 2020 impervious surface area (ISA) projection based on observed rates of ISA change as a function of population from 2006 to 2011. The analysis shows that urbanization in the U.S. implicitly includes a 'cultural character' whereby depending on the region, cities are either built horizontally with large ISA per capita or vertically with a minimal spatial footprint. This 'cultural character' can also be forced by land availability, topography and inland water. In other regions, cities seem to have adapted to their population growth and adjusted their ISA use per capita.

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References:
Bounoua L., Nigro J., P. Zhang, K. Thome: Mapping Impact of Urbanization in the Continental U.S. from 2001-2020, in preparation.

Data Sources: Landsat-based National Land Cover Dataset to characterize the impervious surface area (urban) and MODIS 500m-land cover classification along with the CIESIN Gridded Population of the World and the U.S. Census Bureau 2020 National Population Projection. The 1:500k USA Urban Area boundaries (Esri, Department of Commerce, Census Bureau, Geography Division) were used to calculate population and ISA statistics within each urban area.

Technical Description of Figures:
Maps: **a)** 2001-2020 population change in persons for the southwestern region of the U.S; **b)** 2001-2020 ISA change (% of urban area as demarcated by the 1:500k USA Urban Area boundaries) for the southwestern region of the U.S. The major urban areas included in a) and b) are Las Vegas, Los Angeles, Phoenix, Salt Lake City, San Diego, and San Francisco; **c)** 2001-2020 population change in persons for the northeastern region of the U.S; **d)** 2001-2020 ISA change (% of urban area as demarcated by the 1:500k USA Urban Area boundaries) for the northeastern region of the U.S. The major urban areas included in c) and d) are Baltimore, Boston, Hartford, New York City, Philadelphia, and Washington D.C. The table below lists 2001-2020 population and ISA change for these select urban areas.

Urban Area	Population (persons)	ISA (%)	Urban Area	Population (persons)	ISA (%)
Baltimore, MD	291,110	10.94	Las Vegas-Henderson, NV	230,182	44.76
Boston, MA--NH--RI	391,812	14.29	Los Angeles-Long Beach-Anaheim, CA	3,552,181	9.55
Hartford, CT	90,467	13.16	Phoenix-Mesa, AZ	669,737	44.76
New York-Newark, NY-NJ-CT	1,712,144	12.14	Salt Lake City-West Valley City, UT	189,288	31.38
Philadelphia, PA--NJ--DE--MD	405,285	15.55	San Diego, CA	762,902	9.01
Washington, DC--VA--MD	622,948	14.05	San Francisco-Oakland, CA	839,030	3.40

Graphs: e) 2001-2020 population change vs. ISA change for select urban areas in the northeastern region of the U.S. Note that for New York City there is a projected increase in population of ~2 million people while for Hartford the population increase is only ~90,000 people, yet the ISA change for both cities is about the same. This reflects the vertical growth that is occurring in the New York City area where population use of per capita ISA is minimal compared to Hartford . *f)* 2001-2020 population change vs. ISA change for select urban areas in the southwestern region of the U.S. Note that for Los Angeles ISA change is small despite the projected increase in population of ~3.5 million people. In contrast, for Phoenix a smaller change in population triggers a greater increase in ISA. These examples reveal the horizontal vs. vertical building patterns and do represent regional 'cultures'.

Scientific significance, societal relevance, and relationships to future missions:
Scientific significance: 1) Urbanization in the U.S. includes a 'cultural character' whereby depending on the region, cities are either built horizontally resulting a large spatial footprint or vertically with a minimal spatial footprint despite the magnitude in population increase. 2) In some regions, cities seem to have adapted to their population growth and adjusted their ISA use per capita.

Societal relevance: US cities are home to more than 50% of the population and this is where climate change will be felt the most.

relationships to future missions: Defines the need for a high resolution global mapping of urban settings to assess their interaction with the global environment.

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